CHAPTER 2

Biodiversity: Issues and Implications

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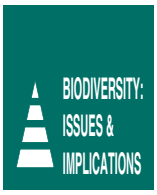
Importance of Biodiversity



Biodiversity is a shortened form of the term *biological diversity*[1]—the spectrum of life forms and the ecological processes that support and sustain them. Biodiversity supports the integrity of the ecological systems upon which humans depend. These ecological systems (*ecosystems*) are self-sustaining units, and to a certain extent they can absorb disturbance without suffering loss of function. However, repeated or large-scale human disturbance inevitably changes ecosystems and can threaten their viability.

Biological diversity—or biodiversity "for short"—is the spectrum of life forms and the ecological processes that support and sustain them.

Humans have a profound and continuing impact on Wisconsin's ecological systems. While some may think of tropical rainforests as the only areas where ecosystems are in danger, continuing human population growth here at home creates pressures on our natural communities. Human population growth, coupled with land development patterns and high per-capita consumption of energy and natural resources, leads to pressure on habitat from development, air and water pollution, and extraction of resources for energy and other uses. All of this can lead to loss of biological diversity.

As human populations grow and our needs and ability to use the environment increase, we will continue to alter ecological systems even though the absolute limits of ecological systems to absorb human activities are unknown. At the same time, we depend on these systems for clean air and water, food, shelter, and the raw materials that support many of Wisconsin's industries. In addition to these benefits, plants have yielded life-saving drugs, and studies of animals have provided valuable insight into navigation, biochemistry, linguistics, and medicine. Conserving biodiversity will help sustain the ecological systems that we depend on. It will also preserve options for future decision-making.

Biodiversity is complicated, occurring at many different levels. For purposes of study and management, biological diversity is usually grouped into four levels: *genetic diversity, species diversity, community diversity*, and *ecosystem diversity* (Fig. 1).

Genetic diversity consists of the spectrum of genetic material carried by different organisms. Genetic diversity within a population of a plant or animal species has the potential to change over time, allowing species to adapt to environmental conditions and retain vigor. Although genetic diversity may be expressed in visible characteristics, such as color, size, and shape, much is expressed in biochemical processes that are hidden from view. Individuals within a population carry a variety of genes. If something happens to reduce the size or variety of the gene pool, then that population's genetic diversity is compromised.

Species diversity results from the variety of *species* in a geographic area. It includes not only the number of species in

[1] Terms in italics are defined in the glossary.

Genetic Diversity

The variation in genetic composition of individuals within and among species. (e.g. variation within a population of rabbits)

Species Diversity

The variety of different species found in an area. (e.g. the variety of species found in a prairie)

Community and Ecosystem Diversity

The variety of physical environments and biotic communities over a landscape. (e.g., the variety of forests, grasslands, wetlands and aquatic systems over a region)

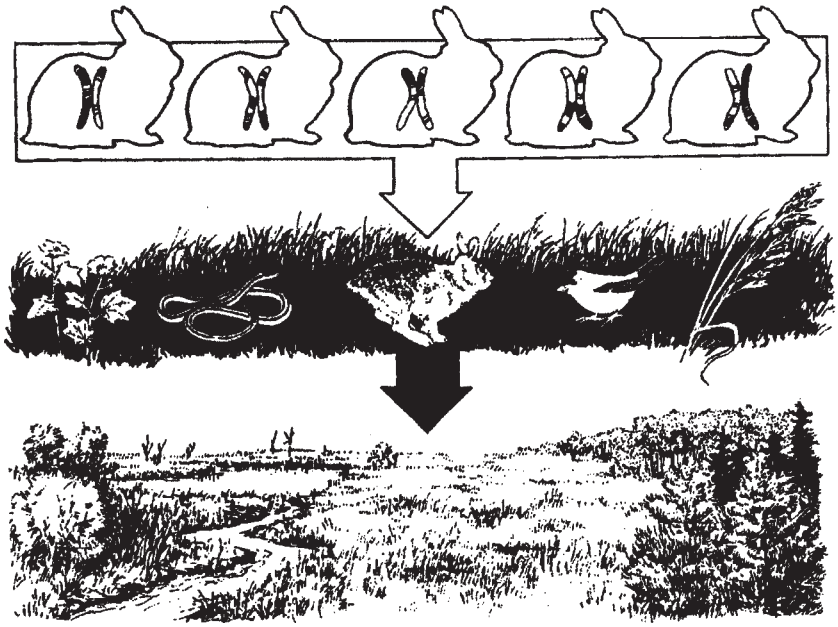


Figure 1

Biological diversity occurs at four interrelated levels, adapted from Temple (1991).

the area but also their relative abundance and spatial distribution. Species are the most familiar level of diversity because they can be classified and counted, and many, though not all, are readily visible. Species include everything from soil fungi and insects to eagles and deer, from darters to muskies, and from mosses and lichens to hemlock and red pine. Every species has a niche, or a role it plays in a natural community, defined by how individuals of a species carry out their activities, use resources, and occupy space. Understanding the niche of a single plant or animal species requires in-depth study as well as an understanding of the environment in which the species lives and interacts.

A *community* is an assemblage of species living together in a particular area at a particular time. Communities usually bear the name of their dominant plant species, for example, pine barrens, sedge meadows, and cedar glades. However, the community includes all of the plants living in association with the dominant species plus all of the animals present at a given time. Communities are often perceived as static, but they are actually in a constant state of change—change usually occurs, however, at a rate too slow for humans to note in our brief lifetimes. Communities range in size from less than an acre (e.g., shaded cliff community) to thousands of acres (e.g., mesic hardwood forest). The diversity of a given community is determined by the variety and type of species present, the intricacies of their interactions, and the age and stability of the community. The community diversity of a landscape is influenced by the number of communities present, the degree of difference among the communities, and how the communities are distributed.

Conserving biodiversity will help sustain the ecological systems that humans depend on and preserve a wide range of options for the future.

An *ecosystem* is a dynamic complex of plants, animals, and microorganisms and their associated non-living environmental components interacting as an ecological unit. An ecosystem takes the biotic community one step further to encompass interactions with the abiotic environment, which includes moisture, temperature, oxygen, sunlight, soil, and all the other non-living physical and chemical conditions. The *biotic* (living) and *abiotic* (nonliving) *environment* interact continuously. Often, this interaction takes the form of complex processes that move gases, chemicals, and

The interactions that connect microorganisms, plants, and animals with the nonliving environment are all part of biological, physical, and chemical cycles that have been occurring on Earth for millions of years.

minerals in endless cycles such as the carbon cycle, water cycle, and nutrient cycle. For example, a downed tree will, through leaching and decomposition, recycle its nutrients back to the ecosystem to be used by other living organisms. The canopy gap created when the tree was downed will let in sunlight, altering conditions on the forest floor and providing opportunities for new plant species to become established. While all this is happening, the tree is providing shelter for mice and salamanders, food for invertebrates, and substrate for plants. This tiny ecosystem exists within a much larger forest ecosystem that might encompass thousands of square miles. In this larger system are hundreds of species of plants, hundreds of animal species, and probably thousands of species of microorganisms. Ecosystems are constantly changing in response to short-term human impacts such as timber harvest and naturally caused perturbations such as fire or disease, along with long-term influences such as climatic change.

Within ecosystems, the processes of ecological *succession*—that is, the progressive changes in species composition, organic structure, and energy flows over time—are also constantly at work. Large ecosystems contain a mosaic of successional stages—a forest may have large areas of fully mature trees, but will also have open areas with shrubs, patches of young trees growing up after a blowdown, and other vegetative communities within the larger matrix of the mature forest. Ecosystems are in turn part of the larger *landscape* of adjacent and interacting ecosystems. Surrounding lands can significantly affect the character of an ecosystem; therefore, ecosystems must be considered within the context of the broader landscape.

Wisconsin is blessed with great biodiversity. Located at the junction of three of North America's *six biotic provinces*—the eastern deciduous forest, the northern boreal forest, and the temperate grasslands—we have a wealth of species and natural communities. Curtis (1959) delineated 21 major plant communities for Wisconsin, plus 13 lesser communities restricted to small areas. Approximately 1,800 native vascular plant species are known in Wisconsin, along with 657 species of vertebrates. In addition, there are thousands of species of nonvascular plants and invertebrates. DNR's challenge is to work with Wisconsin citizens to conserve this biological wealth.

Wisconsin is located where three of North America's great natural borders join. Here, East meets North and West to create a wealth of biological diversity. It is DNR's challenge to work with Wisconsin citizens to conserve this natural heritage.

Historical and Current Perspectives in Resource Management

Throughout the history of natural resources management, decisions have been based in part on the personal values of individuals. Today, each DNR employee has a personal history and set of values related to natural resource management. Consider, for example, a group of managers standing on a hillside looking out over an expanse of land below. One person notes the low mounds and plains that indicate glacial topography. Another's eyes go straight to the creek meandering through the scene; this person wonders what fish are present and if they get to any size. Another person in the group spots a small plot of millet growing on the otherwise fallow land and comments that it's probably a wildlife food patch. Yet another scans the land with binoculars, looking for wild flowers and signs of any unusual habitat. Some think of this piece of land as potentially something to manage for a natural "product" such as grouse; others in the group think of it primarily as something to preserve or to restore to its original